Chapter 4  Circulatory Pathways

♦ Systemic Arteries
- Arteries carry blood away from the heart to the various organs of the body.
- The aorta is the longest artery in the body; it branches to give rise to all of the smaller arteries that form the systemic circulation.
- The aorta consists of 4 sequential regions: the ascending aorta, aortic arch, thoracic aorta, and abdominal aorta (Figure 21.18, Tortora).

♦ ascending aorta
- the initial portion of the aorta
- extends off of the left ventricle in an upward direction.
- The only branches of the ascending aorta are the right and left coronary arteries, which supply blood to the heart wall (Figure 20.8a, Tortora).

♦ aortic arch
- the portion of the aorta that is shaped like a cane handle
- connects the ascending aorta with the thoracic aorta
- 3 arteries branch off of the aortic arch: the brachiocephalic artery (also called the brachiocephalic trunk), the left common carotid artery, and the left subclavian artery (Figures 21.18 and 21.19, Tortora).
- The brachiocephalic trunk further divides into a right common carotid artery and a right subclavian artery.

♦ Note that there is only 1 brachiocephalic artery, which is located on the right side of the body.
- There isn’t a left brachiocephalic artery; the left common carotid artery and left subclavian artery directly branch off of the aortic arch.

-Common Carotid Arteries
- Each common carotid artery branches into an external carotid artery and an internal carotid artery.
  1. external carotid arteries
     - supply blood to the face, nose, oral cavity (teeth, tongue, etc.), ear, scalp, neck, pharynx, larynx, and thyroid gland
  2. internal carotid arteries
     - supply blood to the brain, pituitary gland, and the eye

Subclavian Arteries
- Each subclavian artery branches to form the vertebral artery, which supplies blood to the brain and spinal cord.
The subclavian artery continues on into the axillary region and is now called the **axillary artery**. The axillary artery supplies blood to the axilla, shoulder, and chest wall (skin and pectoral muscles).

The axillary artery enters the arm and becomes the **brachial artery**. The brachial artery supplies blood to arm.

Near the elbow, the brachial artery branches to form the **radial artery**, which follows the radius, and the **ulnar artery**, which follows the ulna. These arteries supply blood to the forearm.

Near the wrist, the ulnar artery and the radial artery unite to form a **superficial palmar arch** and a **deep palmar arch**. The palmar arches supply blood to the palm of the hand.

**Digital arteries** branch off of the palmar arches and supply blood to the fingers and thumb.

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**-Arteries of the Brain**

- As mentioned earlier, the internal carotid arteries and the vertebral arteries are the major arteries that supply blood to the brain (Figure 21.19c, Tortora).

1. **internal carotid arteries**
   - Each internal carotid artery branches to form an **anterior cerebral artery**.
   - The left and right anterior cerebral arteries are interconnected via the **anterior communicating artery**.

2. **vertebral arteries**
   - Along the ventral surface of the brainstem, the left and right vertebral arteries merge to form the **basilar artery**.

   The basilar artery branches to form the **posterior cerebral arteries**.

   The posterior cerebral arteries branch to form the **posterior communicating arteries**, which connect with the internal carotid arteries.

- Note that the internal carotid arteries and the basilar artery are interconnected by a circular anastomosis called the **Circle of Willis** (**cerebral arterial circle**).
- An anastomosis is a connection between the same type of blood vessels.
- The blood vessels that comprise the circle of Willis include the anterior cerebral arteries, anterior communicating artery, internal carotid arteries, posterior communicating arteries, and posterior cerebral arteries.
- This arrangement provides an alternate pathway through which blood can flow if an internal carotid artery or vertebral artery becomes blocked or damaged.

• thoracic aorta
  - the portion of the aorta that is located in the thoracic cavity
  - supplies blood to the chest wall and to many organs of the thoracic cavity
  - There are several branches of the thoracic aorta (Figure 21.20, Tortora):
    1. bronchial arteries
       - supply blood to the bronchi and bronchioles of the lungs
       - Note that the pulmonary arteries actually supply blood to the alveoli of the lungs.
    2. esophageal arteries
       - supply blood to the esophagus
    3. pericardial arteries
       - supply blood to the pericardium
    4. intercostal arteries
       - supply blood to the intercostal muscles, a portion of the spinal cord, and the upper back
    5. superior phrenic arteries
       - supply blood to the diaphragm

• abdominal aorta
  - the portion of the aorta that is located in the abdominal cavity
  - supplies blood to abdominal organs
  - 3 unpaired arteries branch off of the abdominal aorta: the celiac trunk, superior mesenteric artery, and the inferior mesenteric artery (Figures 21.20 and 21.21, Tortora).
    1. celiac trunk
       - divides into 3 branches: the left gastric artery, common hepatic artery, and the splenic artery
       a. left gastric artery
          - supplies blood to the stomach
       b. common hepatic artery
          - supplies blood to the liver and gallbladder
       c. splenic artery
          - supplies blood to the spleen and pancreas
2. superior mesenteric artery
   -supplies blood to the small intestine and the first half of the large intestine

3. inferior mesenteric artery
   -supplies blood to the second half of the large intestine

5 paired arteries branch off of the abdominal aorta: the inferior phrenic arteries, suprarenal arteries, renal arteries, gonadal arteries, and the lumbar arteries (Figure 21.20, Tortora).

1. inferior phrenic arteries
   -supply blood to the diaphragm

2. suprarenal arteries
   -supply blood to the adrenal glands

3. renal arteries
   -supply blood to the kidneys

4. gonadal arteries
   -supply blood to the gonads and other structures
   -In men, the gonadal arteries are called testicular arteries; they supply blood to the testes.
   -In women, the gonadal arteries are called ovarian arteries; they supply blood to the ovaries, fallopian tubes, and uterus

5. lumbar arteries
   -supply blood to the spinal cord and to the lower back

-Near the fourth lumbar vertebra (L4), the abdominal aorta splits into 2 major arteries, the right and left common iliac arteries (Figure 21.22, Tortora).

-Right and Left Common Iliac Arteries
  -Each common iliac artery branches to form an internal iliac artery and an external iliac artery.

  internal iliac arteries
  -supply blood to the pelvis, urinary bladder, buttocks, penis and scrotum (in men), and vagina (in women)

  external iliac arteries
  -supply blood to the lower limbs
  -Branches
    -As each external iliac artery descends into the thigh, it becomes the femoral artery. The femoral artery supplies blood to the thigh.

Behind the knee, the femoral artery becomes the popliteal artery, which branches into the anterior
tibial artery and the posterior tibial artery. The anterior tibial artery supplies blood to the anterior leg, while the posterior tibial artery supplies blood to the posterior leg.

Near the ankle, the anterior tibial artery becomes the dorsalis pedis artery, which supplies blood to the ankle. As it descends, the dorsalis pedis branches to form the dorsal arch (arcuate artery), which supplies blood to the dorsal surface of the foot.

In addition, the posterior tibial artery eventually branches into the lateral plantar artery and the medial plantar artery, which supply blood to the plantar surface of the foot. These arteries are interconnected by the plantar arch. The digital arteries branch off of the plantar arch to supply blood to the toes.

♦ Systemic Veins
- Veins carry blood from the organs of the body back to the heart.
- Veins are more superficial than arteries and, therefore, can often be seen through the skin.
- As you probably noticed earlier, arteries are named in a distal direction; veins, however, are named in a proximal direction.
- 3 major veins empty into the right atrium of the heart: the superior vena cava, inferior vena cava, and coronary sinus (Figure 21.23, Tortora).
  1. superior vena cava
     - drains blood from the head, neck, upper limbs, and chest
  2. inferior vena cava
     - drains blood from the abdomen, pelvic organs, and lower limbs
  3. coronary sinus
     - drains blood from the heart wall
• veins draining into the superior vena cava
  - Venous Return From the Upper Limbs, Head, and Neck (Figures 21.25 and 21.24, Tortora)

The digital veins drain the fingers and thumb of the hand.

The digital veins empty into the superficial palmar venous arch, the deep palmar venous arch, and the palmar venous plexus. These veins drain the palm of the hand.

The palmar venous arches and the palmar venous plexus empty into the following veins: basilic vein, median antebrachial vein, ulnar vein, radial vein, and cephalic vein. These veins drain the forearm.

Both the basilic vein and the cephalic vein course through the forearm and then ascend into the arm. In front of the antecubital region, the cephalic vein and basilic vein form a side interconnection through the median cubital vein. The median cubital vein is the vein from which blood samples are typically obtained. Before leaving the forearm, the ulnar vein and the radial vein combine to form the brachial vein that ascends into the arm. Hence, the basilic vein, the cephalic vein, and the brachial vein are the major veins of the arm. Consequently, the arm is drained by these veins.

As it approaches the axilla, the basilic vein joins the brachial vein to form the axillary vein. The axillary vein drains the axilla, shoulder, and chest wall (skin and pectoral muscles).

The axillary vein and the cephalic vein ultimately join to form the subclavian vein.

After traveling for a short distance, the subclavian merges with the external jugular vein, internal jugular vein, and the vertebral vein, forming the brachiocephalic vein. Note that there are 2 brachiocephalic veins, but only 1 brachiocephalic
artery. The external jugular vein drains the scalp and ear. The
internal jugular veins drains the brain, pituitary gland, eye, face,
oral cavity (teeth, tongue, etc.), nose, neck, pharynx, larynx, and
thyroid gland. The vertebral vein drains a portion of the spinal cord
(but not the brain).

Near the heart, the brachiocephalic veins combine, creating the
superior vena cava, which drains into the right atrium.

-Venous Return From the Thorax (Figure 21.26, Tortora)
- The azygous system drains various regions of the thoracic cavity; this
system consists of the azygous vein and the hemiazygous vein (also called
the accessory hemiazygous vein)
- The hemiazygous veins drains into the azygous vein, which drains into
the superior vena cava.
- The azygous vein and the hemiazygous vein receive blood from
the following veins:
  1. intercostal veins
     - drain blood from the intercostal muscles and upper back
  2. esophageal veins
     - drain the esophagus
  3. bronchial veins
     - drain the bronchi and bronchioles of the lungs

- veins draining into the inferior vena cava
  - The inferior vena cava is formed by the union of the right and left
common iliac veins (Figure 21.27):

- Right and Left Common Iliac Veins
  - Each common iliac vein is formed by the union of an internal
iliac vein and an external iliac vein.

- Internal iliac vein
  - drains the pelvis, urinary bladder, buttocks, penis and scrotum
    (in men) and vagina (in women)

- External iliac vein
  - drains the lower limbs
  - Formation
    The digital veins drain the toes of the foot.
The digital veins empty into the **dorsal venous arch** and into the **plantar venous arch**. The dorsal venous arch drains the dorsal surface of the foot, while the plantar venous arch drains the plantar surface of the foot.

The dorsal venous arch ultimately empties into the **anterior tibial vein** and the **great saphenous vein**. The anterior tibial vein drains the anterior leg. The great saphenous vein courses along the medial side of the leg and thigh and drains that entire area. Hence, the great saphenous vein is the longest vein of the body. The plantar venous arch empties into the **posterior tibial vein**, which drains the posterior leg.

In the back of the knee, the anterior tibial vein and the posterior tibial vein join to form **popliteal vein**. The popliteal vein drains this area of the knee.

The popliteal vein ascends and becomes the **femoral vein**, which drains the thigh.

The femoral vein ascends. Near the lower pelvis, the femoral vein joins with the great saphenous to form the **external iliac vein**.

Once formed, the inferior vena cava ascends through the abdomen. 5 **paired** abdominal veins drain into the inferior vena cava: the gonadal veins, renal veins, suprarenal veins, inferior phrenic veins, and hepatic veins (Figure 21.26, Tortora).

1. **gonadal veins**
   - called **testicular veins** in men and **ovarian veins** in women
     - The testicular veins drain the testes, while the ovarian veins drain the ovaries, fallopian tubes, and uterus.
   - Note that in actuality, only the right gonadal vein drains into the inferior vena cava, while the left gonadal vein drains into the renal vein.
2. **renal veins**  
   - drain the kidneys

3. **suprarenal veins**  
   - drain the adrenal glands

4. **inferior phrenic veins**  
   - drain the diaphragm

5. **hepatic veins**  
   - drain the liver  
   - Note that there isn’t a direct drainage of blood from the organs of the digestive system.  
   - The blood from these organs must first go to the liver via the **hepatic portal vein**.  
     - This allows the liver to screen the blood coming from the gastrointestinal tract.  
     - If there is excess glucose, the hepatocytes (liver cells) take up the glucose and store it as **glycogen**.  
     - Excess vitamins (A, D, E, K, and B₁₂) and minerals (iron and copper) in the blood are also removed and stored in the hepatocytes.  
     - Any toxic substances (like drugs and alcohol) are removed and detoxified by the hepatocytes and then either reintroduced back into the blood or excreted into bile.

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5 **unpaired** veins empty into the hepatic portal vein:  
superior mesenteric vein, inferior mesenteric vein,  
splenic vein, gastric vein, and cystic vein (Figure 21.28, Tortora)  
   a. **superior mesenteric vein**  
      - drains the small intestine and the first half of the large intestine  
   b. **inferior mesenteric vein**  
      - drains the last half of the large intestine  
   c. **splenic vein**  
      - drains the spleen and the pancreas  
      - merges with the inferior mesenteric before entering the hepatic portal vein  
   d. **gastric vein**  
      - drains portions of the stomach  
   e. **cystic vein**  
      - drains the gallbladder